(1) The bacteriology treats of bacteriological methods, pathogenic bacteriology, and bacteriology as applied in hygiene in the examination of water, milk, foods, disinfectants, &c. A few slips need correcting—*e.g.* the statement that an antibody consists of two parts (p. 19)—and the Wassermann reaction needs amplifying somewhat; otherwise there is little to criticise, and some portions of the book are particularly good, *e.g.* the section on disinfectants.

(2) The pathology suffers somewhat from the attempt to include everything in so small a book—*e.g.* diseases of the teeth and parasitic worms—and other more important and fundamental processes are in consequence too briefly discussed. Fatty infiltration and degeneration are treated as though they are quite distinct. It is stated that active immunity is conferred by the injection of an anti-serum, whereas it is correctly stated a couple of lines later that this procedure confers a passive immunity. The diagrams indicating the interaction that occurs in the Wassermann reaction should render this subject clear.

R. T. H.

Senior Chemistry. By Dr. G. H. Bailey and H. W. Bausor. Pp. viii+509. Price 4*s.* 6*d.*
Senior Magnetism and Electricity. By Drs. R. H. Jude and J. Satterly. Pp. viii+446. Price 5*s.*
Senior Heat. By Drs. R. W. Stewart and J. Satterly. Pp. viii+300. Price 3*s.*
(London: W. B. Clive, University Tutorial Press, Ltd., 1911.)

ALL these books are based upon previous volumes issued by the same publishers. The first is an adaptation apparently of Dr. Bailey's "Chemistry for Matriculation," which was reviewed in our issue of May 11, 1911 (vol. lxxxvi., p. 345); the second of Dr. Jude's "Matriculation Magnetism and Electricity," noticed in these columns on June 23, 1910 (vol. lxxxiii., p. 485), and the third of the late Dr. Stewart's book on heat, noticed at the same time as the volume on magnetism and electricity referred to.

It would seem that the present volumes cover those parts of the respective subjects included in the syllabuses for candidates presenting themselves at the Senior Local Examinations conducted by the University of Cambridge.

Fifty Useful Metric Equivalent Tables. (London: The Central Translations Institute, n.d.) Price 6*d.* net.

PROVISION is made in these tables for the range of equivalents likely to arise in commercial dealings between this country and others using the metric system. The calculations are based upon figures supplied by the Board of Trade. The price equivalents deal with feet, yards, square feet, square yards, cubic feet, gallons, pounds avoirdupois, hundredweights, and forty cubic feet measurements—which are useful for checking freight charges. The prices are calculated at the rate of exchange of 25.22 francs to the £.

A Handbook of Physics and Chemistry. By H. E. Corbin and A. M. Stewart. Pp. viii+519. Fourth edition. (London: J. and A. Churchill, 1911.) Price 7*s.* 6*d.* net.

THE first edition of this book was reviewed in NATURE of January 4, 1900 (vol. lxi., p. 221). It will suffice to say that in its present form the volume covers the extended syllabus of work required for the first examination of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons. Additional articles have been introduced in the present edition on hydrostatics, the polarisation of light, and Röntgen rays.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Electricity and Vegetation.

WITHOUT pretending to answer the question raised by Mr. Benham at the conclusion of his letter on p. 41 of NATURE of November 9, and without prejudging the results of recent experience on electrification of crops as reported on by Dr. Priestley and other impartial investigators, I would remind him and your readers generally that it is unsafe to attach a positive conclusion to a negative result obtained by supposed electrification of a wire network over a field, unless there is reasonable guarantee that such network was really kept positively electrified during considerable periods.

For instance, it has been attempted in the past, and it is still tempting, to supply electricity to a network by means of elevated spikes, arranged so as to utilise the gradient of potential naturally existing in the atmosphere. But think what singularly perfect insulation would be required to enable electricity slowly supplied in this way to accumulate until a fizzing point was reached. The attainment of such potential over a large area would in this climate be quite impracticable except when a thundercloud was passing overhead.

The same difficulty of adequate insulation must have militated against many attempts made in the past to supply electricity from artificial but old-fashioned high-potential sources, especially when the area to be supplied extended over many acres.

It must be further remembered that any metallic network not really charged, but kept practically at zero potential by leakage to earth, would be presumably detrimental to the growth of plants beneath it; inasmuch as it would tend to screen them from the natural inductive electrification to which they are entitled.

OLIVER LODGE.

Fish and Drought.

THE summer of the year 1911 will long be remembered for its excessive heat and dryness. These were especially trying to the inhabitants of streams and shallow lakes or ponds. I had the opportunity of studying a remarkable instance of this, which I think is worth recording.

The Château of Marchais, with its magnificent domain, the property of the Prince of Monaco, lies about 16 kilometres east of Laon, in the department of Aisne, and is well known as one of the best shooting estates in France. The sketch (Fig. 1) represents the park. It occupies a rectangle surrounded by a ditch or moat, A, B, C, D, consisting of four canals, each 1250 metres long and 16 metres wide, and carrying usually a depth of 1½ metres of water. These canals form a continuous sheet of water, 5 kilometres long, and there is a bridge, *a*, *b*, *c*, *d*, over each of them. The country, though well-wooded, is flat and peaty, and the level of the water in the ditch is that of the water in the ground all round it. Like the ground-water, it is subject to rise and fall according to the wetness or dryness of the season.

When I arrived on the morning of September 29, I observed that the ditch was quite dry, with the exception of the small tank or enclosure (*f*) for ducks at the lodge known as the Porte Rouge, where entry to the park is obtained over the bridge marked (*b*). Yet the water of the ditch is always full of fish, principally carp, tench, perch, and pike. Now there was nothing but dry mud. *With the water the fish had entirely disappeared, and without leaving a single dead one to mark where they had before abounded.*

On the evening of September 29 a violent storm of wind and rain broke, and it raged over the whole of northern Europe until October 1. I was curious to see the effect which this first important rain, which marked the breaking of the drought, would have on the ditch.

It is right to say that the full significance of the dryness of the ditch and the absence of dead fish had not sufficiently impressed me. I only felt that I was witnessing a remarkable occurrence in nature and it excited my curiosity, but at first this curiosity went very little beyond considering how long it would take for the water to get back. With only this in my mind, I went round the park on the afternoon of September 30, when the weather had moderated a little, and I found that pools of water had begun to collect in places in the ditch, but I did not examine them, and I arrived at the conclusion that a little steady wet weather would soon fill the ditch up again.

On October 1 the weather was still very bad, but between the showers I took a walk along the margin of the ornamental water (*h*) on the west side of the château (*k*), which is connected with the south canal of the moat. A pool of water had collected here, and there was quite a quantity of small fish, not more than 10 or 12 centimetres in length, swimming about in the water, which did little more than cover its muddy bottom to a depth of at the most 4 or 5 centimetres, in which these small fish were able to swim. I noticed that the water was turbid and that the mud was everywhere being stirred up by the fish. They were darting hither and thither, being disturbed by my presence on the bank, and, whenever they altered their course, they contrived to raise a dense cloud of mud, in which they were able for a short time to conceal themselves from view.

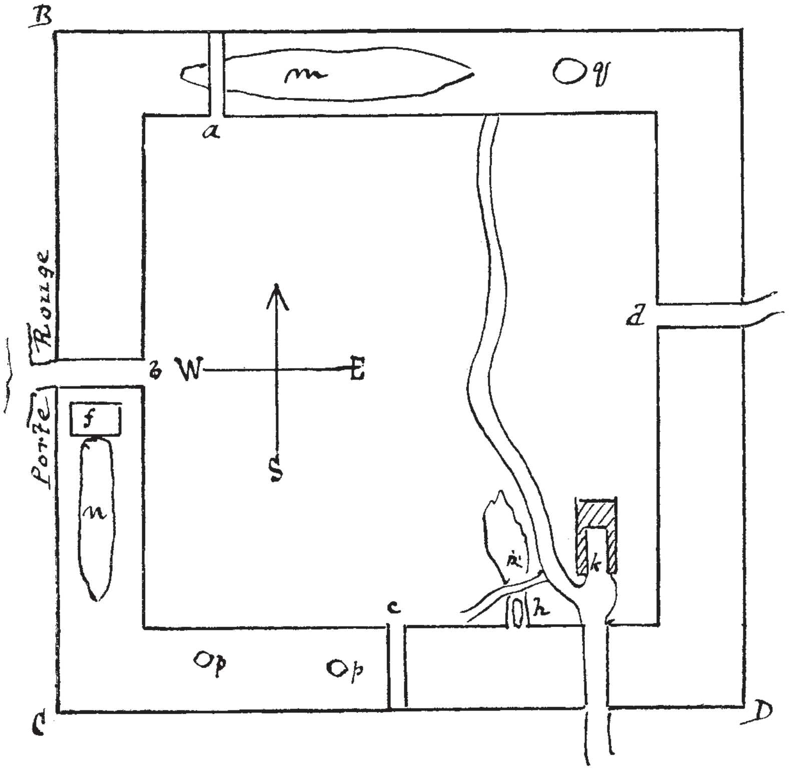

FIG. 1.—Sketch Plan of the Park of Marchais.

Two days before these fish were invisible, and now they had reappeared in an isolated shallow pool, which also had no existence two days before. *It was evident that all these fish had been covered by the dry mud, and must have released themselves the moment they thought there was enough water for them to swim in.* There was not by any means too much water for the crowd that was moving about in it. I was fascinated by what I saw, especially as it seemed to be in every way likely that the process of release was still going on. But the release of a buried fish would be sure to be accompanied by a cloud of mud, which could not be easily distinguished from that produced by a fish already in freedom and swimming about. Still, considering the shallowness of the water and the very favourable position for following everything that went on in it which I occupied on the bank, I was convinced that there would be some noticeable difference between the two classes of cloud, and I was not mistaken. After waiting and watching for some time, I saw a mud-cloud rise in the very shallow water, bringing a fish with it to the surface belly upwards. It lost no time in righting itself and swimming away with the others. A living fish can adopt this attitude only when it has not got full control over its movements, and this is pretty sure to be the case at the moment when it releases itself from burial. By waiting a little longer I witnessed two or three repetitions of this remarkable act.

In a pool such as that which I had under observation, in which the water was not more than two or three centimetres deep, the liberated fish reaches the surface almost as soon as it quits the bottom. In any case it is highly probable that the fish would arrive at the surface before it had fully seized the situation, and the nervous impulse had arrived at the muscles and started them in their righting and locomotive activity.

In water a very little deeper it is probable that the fish would be able to right itself before floating clear of the cloud of mud produced by its struggles in the act of self-exhumation.

In the afternoon I went round the park, and found an extensive pool (*m*) which had collected in the north canal and occupied its western half. There were great shoals of fish, principally perch, darting about, and, in their alarm at being surprised in unusually shallow water, stirring up clouds of mud everywhere. Amongst them was one large pike, quite 40 centimetres in length. The water shoaled off to nothing at both ends of the pool, and in the middle it was perhaps 30 centimetres deep. The pool was far too long to be watched like the smaller one, and I was not able to observe any individual release from the mud. However, I noticed that, with the exception of the large pike, the fish were all small; I estimated them to be not more than 10 to 12 centimetres long.

From the western end of this pool, round the north-west corner and along the western canal to the bridge (*b*), at the Porte Rouge, the canal was quite dry. At the Porte Rouge there was the small enclosed tank for ducks (*f*), and beyond it the canal was again dry. The bottom of this canal does not consist of the fine mud which is found in the north canal; it is hard, sandy, and marly, and there was no sign of life in it anywhere. The same class of bottom with absence of life prevailed in the south canal.

On October 2 the weather had improved, although it was very cold, and I studied the canals both in the morning and the afternoon. In the large pool in the north canal I found the quantity of fish augmented, and I especially noticed that there were many more large fish present than before, and the average size of the fish was decidedly greater than on the previous day; perch of at least 20 centimetres in length were present. The bigger fish had probably started to bury themselves earlier than the smaller ones, and had buried themselves deeper. I saw the big pike of the day before, and two others of the same species, but very much smaller, had appeared. *One dead perch was floating in the pool, the first dead fish that I had encountered.* In the afternoon it seemed to me that the average size of the fish in the pool was still on the increase. The west and north canals presented the same appearance as before.

On October 3 the weather kept fair but cold. I went round the park and found the big pool in the north canal much the same as on October 2, the number of large perch having apparently increased, but there was no new feature of importance. In the course of my tour, after passing the Porte Rouge, I found that the part of the west canal south of this lodge had begun to collect water, which already covered the bottom, forming a pool (*m*), extending to within a short distance of the south-west corner. Under the water, which was perfectly clear, the light grey bottom was still cracked and apparently unsoftened, and there was not a trace of life of any kind. In the south canal the bottom was generally dry, with, however, every here and there pools of water measuring about one metre across, and in these also there was no trace of life. I learned that anglers never fish in these canals, because they know that they will catch nothing.

In the afternoon I revisited the north canal, and instead of following the big pool westwards, which promised nothing new, I turned to the right and followed it eastwards towards the north-east corner. I had not gone very far before I encountered a phenomenon of which I had already perceived the possibility, namely, *a premature resurrection resulting in widespread death.* This part of the canal was apparently dry, in the sense that the bottom was exposed to the air, but nevertheless moist enough to be called wet. Owing, probably, to a slight general rise of the ground-water of the neighbourhood, enough water had been able to filter through the mud of the bottom and to rise to the surface and overflow, producing a very shallow pool (q), not more than 2 or 3 centimetres deep or more than a metre across. The wetting of the mud below by this infiltration must have aroused the sleepers, who then all started to rise at the same time. But when they released themselves from the mud there was not enough water to float them all, and a formidable struggle for existence was going on at the time of my visit, and the quantity of dead and dying fish lying all round the edges of the pool furnished sufficient evidence of its fierceness. The poor fish would no doubt have willingly re-buried themselves and so saved their lives when they perceived their mistake, but the stronger ones, which were in possession of the only part of the pool which could be called liquid, kept shouldering them outwards on to the mud, where they died in the air. When I left the struggle was still going on, and it looked as if the level of the water was falling, so that it is unlikely that many, if any, would be able to retrieve their mistake by burying themselves again. As I left for England the next morning I was not able to continue my observations.

Although the years vary much as regards humidity, and in dry summers the supply of water in the ditch has often fallen to a pretty low ebb, I was informed that the last time that the ditch became quite dry was in the year 1814, almost a hundred years ago; therefore *the experience of the summer of* 1911 *must have been a new one for all the fish in the ditch, yet the general manœuvre of protective burial was carried out without a casualty.* In order to accomplish this a fine instinct was necessary to perceive the impending drying up of the canal, and then commence the operation betimes so as to finish it before desiccation was complete.

It must be remembered that the area of canal having the muddy bottom, which alone is capable of receiving them, is very restricted; and from the number of fish that came out of it in the short time that I was observing they must have been packed very closely, and in such an orderly way that, with the return of water in sufficient quantity, they were able to take to it again apparently without having suffered at all.

Although the instinct of the fish seems to have sufficed to make them foresee and provide for the dryness, it does not seem in all cases to have been sufficient to enable them to judge correctly the right moment for beginning their release.

Of the different species which inhabit the waters of the ditch, the carp and the tench have the habit of burying themselves in the mud every winter; but the perch and the pike have not this habit; both can be caught at any time in winter, even under a covering of ice; yet both the pike and the perch must have buried themselves with quite as much skill as the carp or the tench.

But in a climate like that of this part of France shallow lakes and ponds may suffer shortage of water by congelation as well as by evaporation; and the Prince informed me that he remembered one winter when in many places the water of the ditch was frozen almost, if not quite, to the bottom, and quantities of pike and perch were frozen into the ice. This form of desiccation did not prompt them to seek refuge in the mud.

It is evident that if the summer of 1911 had marked the beginning of a secular period of dryness, such that the canals were not again to be flooded, the fish which took to the mud in that summer would be kept there. They would die and decay *in situ*, and would be perfectly preserved in well-arranged though crowded masses. Eventually, if the change of climate was final, they would form a rich and interesting bed of fossil fishes. But the interest would depend not only on the abundance of fossils in the muddy matrix of one part of the trough-like formation; it would be intensified by their complete absence in the hardened marly matrix of the other part.

Before serious drying took place the ditch, or trough, was covered by a continuous sheet of water in which the fish and other creatures could circulate freely to all parts. So soon, however, as actual desiccation appeared to be imminent, the fish must have concentrated themselves in a body over the districts of muddy bottom in which they knew they could take refuge as a last resort. *When desiccation was complete every fish in the ditch, without a single exception, had succeeded in burying itself in one or other of these restricted areas of mud. Not one of them appears to have made the mistake of seeking refuge in the marly bottom.* When completely dry the ditch, or trough, consisted of two formations, the more extensive consisting of hard sandy marl and destitute of life, the less extensive consisting of soft mud and teeming with aquatic life. Further, the two formations are contiguous as well as contemporaneous, and together they cover an area of not more than eight hectares.

As illustrating the geological significance of the facts just recorded, the following passage may be quoted from Sir Archibald Geikie's "Text-book of Geology" (1903), p. 1003:—

"The water basins of the Old Red Sandstone might be supposed to have been, on the whole, singularly devoid of aquatic life, inasmuch as so large a proportion of the red sandy and marly strata is unfossiliferous. In some of the basins, where the sediment is not red and sandy, it is evident that life was extremely abundant, as is shown, for example, by the vast quantities of fossil fishes entombed in the grey bituminous flagstones of Caithness and Orkney. It may be observed that where grey shales occur intercalated among red sandstones and conglomerates they are often full of plant remains, and may contain also ichthyolites and other fossils which are usually absent from the coarser red sediments. There would appear to have been occasions of sudden and widespread destruction of fish life in the waters of the Old Red Sandstone, for platforms occur in which the remains are thickly crowded together, yet so entire that they could not have been transported from a distance, and must have been covered over with silt before they had time to decay and undergo much separation of their plates."

The last sentence of this passage seems to describe the actual condition of the muddy bed of the moat round the Park of Marchais as it would appear to a geologist after the necessary interval of time had elapsed which is required to separate the date of the death of the crowd of fishes which voluntarily entombed itself in the mud before desiccation was complete, and the date at which the stratum of mud and remains so produced would be entitled to rank as a geological formation. I do not know if there are any adequate data for arriving at a trustworthy estimation of the probable length of this interval. It is quite distinct from what is understood as the age of the geological formation.

The barren districts of sandy and marly matter at the bottom of the ditch would, after the lapse of the same, or perhaps a shorter, interval furnish perfectly unfossiliferous strata, which would suggest to the geologist of later date that the water basin in which it had been laid down had been singularly devoid of aquatic life. Yet, in a sense, it would not be inaccurate to say that the water basin in which the muddy strata holding the crowded fish remains had been "laid down" teemed with life, and that the barren strata had, in the same sense, been "laid down" in water devoid of aquatic life, although the two bodies of water formed one continuous sheet of very restricted dimensions. *It would seem, therefore, that a material barrier is not necessary to separate even a small body of* *water into two basins and to maintain them distinct, the one of which may be full of life and the other practically barren.*

There is an important point, which should not be missed, in the similarity between what took place this summer at Marchais and what may have taken place in Caithness or Orkney in the Old Red Sandstone period. The fishes which buried themselves in such numbers in the mud this summer, though they were fortunately released, were in the strictest sense contemporaries, and were all buried in the mud within a few days of each other. Moreover, in ordinary circumstances, at least in summer, the mud is untenanted. If the fish were to migrate into the barren waters covering the marly bottom, and their return were barred while the water over the mud evaporated and the secular drought set in, this same mud-bed would be met with in later ages as an unfossiliferous stratum. *So that the fossil fishes which are found in these strata must be held to have gone into occupation only when the signal, intelligible to them, was made that complete desiccation was going to take place. Once in a way this desiccation turns out to be secular, and we have a rich bed of fossils.*

In conclusion, I think that the behaviour of the fish in the ditch at Marchais in the summer of 1911 adds one more fact to the body of evidence which goes to show that, *in the production of geological formations, transportation of material has probably been the exception rather than the rule.*

J. Y. Buchanan.

The Inheritance of Mental Characters.

I have just read Dr. Archdall Reid's paper "Methods of Research," communicated to the Eugenics Education Society. Situated as I am in Scotland, it was impossible for me to attend the discussion which I understand took place recently, and I had no opportunity of reading his paper until he sent it to me. He makes certain statements with regard to a very controversial point; the inheritance of mental characters; and, having had no chance of criticising these, I should be much obliged if you would give me the opportunity of doing so.

Prof. Pearson, as quoted by Dr. Reid, says:—"We inherit our parents' tempers, our parents' consciousness, shyness, and ability, even as we inherit their stature, forearm, and span." This statement may be loosely expressed and open to misinterpretation; but no one has a right to assume, without further explanation, that more is meant than the inheritance of capacity or absence of capacity for making particular acquirements, whether Prof. Pearson actually had this idea in his mind when he wrote or not. At any rate, by ability he undoubtedly means capacity for making acquirements.

Dr. Reid says:—"Pearson's statement is utterly without significance, utterly devoid of all content. Founded with such an air of scientific accuracy on statistics and family histories which have such an appearance of scientific precision, it is so vague as to be quite nonsensical." This statement certainly does not err on the side of vagueness. If it is as true as it is definite it reduces the mental capacity of all men to that dead-level of competence or incompetence which is the apparent ideal of Socialists and trade unions; it necessitates the adoption of some other explanation than the action by selection upon the inborn variations for the evolution of man's capacity for making mental acquirements; and it leaves the undoubted existence of variations in mental capacity, including feeblemindedness, unaccounted for.

Unless Dr. Reid believes that the intellectual development of man has been brought about by the action of some supernatural power or by the inheritance of acquired characters, he must believe that it has been due to the action of natural selection upon inborn variations. The term "mental character" is used by both Dr. Reid and Prof. Pearson in such a way that both inborn and acquired characters are included. The former classes the speaking of English, the latter temper, shyness, and ability, as mental characters. Many, perhaps most, of our mental characters, using the words in this loose sense, are acquirements; but these acquirements depend upon an inborn capacity for making them, and this capacity, like all inborn characters, is subject to variations. Without this it is difficult to see how man's capacity for making mental acquirements could ever have been evolved. Apply the method, which Dr. Reid supports so strongly and explains so clearly, to his own examples and those of Prof. Pearson! All normal English children speak English. All normal French children speak French. The particular language spoken is an acquirement, dependent upon the environment. But it is impossible for Dr. Reid to maintain that, given precisely the same opportunities, all individuals are likely to attain the same degree of skill in the use of the language they have acquired. Moreover, they will vary in the facility with which they acquire skill in the different ways of using the language. Some may readily acquire an abundant flow of words in speaking; others may more easily attain a facile and clear style in writing. Does Dr. Reid believe that a great English orator or writer would not, *ceteris paribus*, have been a great orator or writer simply because his medium happened to be French instead of English? This variability in the capacity for making acquirements must apply to all acquirements. An individual may be able to acquire a high degree of development in music under comparatively unfavourable conditions, but be quite incapable of rising, even to the average, in mathematics under favourable conditions, and *vice versa*. Unless the existence of these variations in mental capacity and the possibility of their transmission from parents to offspring are admitted, it is impossible to account for the evolution of the human intellect by the action of natural selection upon inborn variations.

Now take Prof. Pearson's first example, as quoted by Dr. Reid—temper! I do not think that anyone will quarrel with the postulate that this word is used to express the control, or lack of control, over the emotions exhibited by an individual, the strength of the emotion being a variable quantity according to the susceptibility of the individual to the stimulus producing the emotion. This susceptibility will vary just as grocers' scales vary from a delicate chemical balance, though both respond in a similar manner to the same kind of stimulus. "Good-tempered" implies the possession of a high degree of control or a low degree of susceptibility, or a combination of both. "Bad-tempered" means a lack of control or a great susceptibility, or a combination of both. Dr. Reid might contend that the example of a bad-tempered parent might produce a bad temper in the child. On the other hand, it is at least equally probable that the exhibition of bad temper on the part of a child to a bad-tempered parent would bring swifter and greater punishment than would have been the case had the parent been good-tempered; and thus the bad temper in the child would be more than usually checked. In the absence of direct evidence of a comprehensive and conclusive nature we must assume, given identical environment, that the susceptibility to stimuli tending to produce manifestations of temper is different in different individuals, and is an inborn character; that the capacity for acquiring control over the emotions varies in different individuals, and is an inborn character; and that these variations are transmitted in an increased or lessened degree to their offspring by the parents. These inborn characters are, of course, susceptible to great modification by the environment.

Using, I believe, methods approved by Dr. Reid, I have thus come to the same conclusion that Prof. Pearson has arrived at by a different road, and hold that mental characters are transmitted from parents to offspring, though I fully realise the great extent to which these inborn characters may subsequently be masked by superimposed acquirements. If this conclusion be correct, then the consideration of the inborn mental characters of the parents is even more important, from the eugenic point of view, than that of the inborn physical characters, and far more serious than any question relating to education.

What has surprised me is that on all previous occasions Dr. Reid's opinions seem to have been in complete accord with the arguments put forward here. Hence I do not understand his unqualified condemnation of a statement which does not appear, on the face of it, to be at variance with his own views.

Charles Walker.

Glasgow, October 12.